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AUTHOR Pollio, Howard R
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ABSTRACT

This pamphlet examines notetaking by college students in a discussion of: (1) student attitudes regarding notetaking; (2) observations of notetaking behavior; (3) the relationship between notetaking, quizzes, and college grades; (4) how notes help test performance; and (5) individual differences and notetaking practices. Based on observations and research, several guidelines to lecturers concerning the facilitating of student notetaking are provided. The guidelines include the allowance of tape recorders in the classroom, instructing students on notetaking for lectures, making clear the organizing principle(s) of the lecture, and using verbal "signposts" in the lecture to provide cues as to when something important is being presented. It is argued that when the instructor takes time to assure the completeness of student notetaking, the ability of students to acquire classroom material goes up, thus helping them to learn more effectively. (Contains 21 references.) (GLR)

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No. 68 Fall 1990

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Teaching-Learning Issues

REMEMBRANCES OF LECTURES PAST:
NOTES AND NOTE-TAKING IN THE COLLEGE CLASSROOM

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This number of TEACHING/LEARNING ISSUES has been prepared by Howard R. Pollio, who is Distinguished Service Professor of Psychology and Research Associate at the Learning Research Center at The University of Tennessee.

You can not teach a many anything;
you can only help him to find it
within himself.

Galileo

Learning Research Center
The University of Tennessee, Knoxville

Having your house painted brings unexpected objects to light. In my case, it brought up a set of college notebooks that I hadn't seen in over 30 years. The books were not all that different from those now available in any college bookstore: hard covered, springbound, and displaying the College's seal on the front cover together with some arcane rendition of its name—in my case Collegium Brooklynesis. The notes themselves also were pretty unremarkable. Some were in perfect outline form; and knowing the way I took notes in those days, I was able to discern the guiding hand and stentorian voice of Professor Frances P. Kilcoyne in the production of such order. Others were simply a set of almost-paragraphs; and, although easy to follow, clearly revealed I had at least some small hand in their production. The intimation of a coherent, conceptual organization, however, again suggested a higher order intelligence than my own; and I can still feel the presence of Professor Edward Girden lurking in these pages. Finally, I came across some notes that were largely a collection of words and phrases loosely tied together by arrows and dashes. Sometimes the words referred to books I should have read (but had not), sometimes the words connected by an arrow were enclosed in a box, and sometimes there was an incomprehensible cipher that I can only assume was redolent with meaning when I first jotted it down. There can be no doubt about it—this last set was not the work of an amanuensis; I alone was the author.

One aspect to my undergraduate notebooks that took me a bit by surprise was that in addition to notes going from the front to the back of a brightly tabbed section labeled English, Physics, or History was another set in the same section that went in the reverse direction, from back to front. When I looked more carefully at this latter collection, I remembered they were what we used to call "book notes"; that is, notes taken from reading assignments required by the course. There were no magic markers in those days, and students took notes

rather than highlight texts. Then, too, some of us had to sell our textbooks back to the bookstore and underlining only decreased their resale value. The one thing I did notice about my own book notes was that they were most like those taken in Professor Kilcoyne's class and least like those embroidered with boxes, arrows and/or other idiosyncratic, mystic symbols.

As I held these old notebooks, I felt as if I were back again in some undergraduate classroom. Not every notebook produced the same effect: some vividly brought back the professor and the course, others evoked little or nothing in the way of a memory. But the questions remain: why had I taken these notes in the first place, and why had I kept them over the intervening quarter century? I do not know if many (or any) of our present students will keep their notebooks for as long as I did. What I do know is they all still take notes, and it seemed reasonable to wonder what they would say if I asked them why.

Fortunately there was no need for me to undertake this task personally since a survey of this sort was done some fifteen years ago by James Hartley, a professor at Keele University in the United Kingdom, and by Ivor Davies, a professor at Indiana University in the United States. In their survey they asked students to respond both to open-ended questions such as "Do you feel notetaking is an important activity? Please tell why or why not" as well as to more Yes-No items such as "I take notes to have review materials for examinations." In summarizing their findings Hartley and Davies (1978) noted that student responses to the overall question of why they take notes fell into two major categories, one concerned with the taking of notes per se, and the second with the having of notes once taken. Under the process aspect of note-taking, students reported they believed note-taking helped them attend to the lecture and to discern the structure of its content. They also believed note-taking (and to some degree note-having) would provide evidence to their instructor of having invested effort in understanding the class. In terms of note-having, students reported believing that notes would allow them to reconstruct class content upon review in preparation for tests as well as provide them with material for purposes of subsequent reference, presumably even for those occurring 25-30 years later.

An examination of Hartley and Davies' results summarized in Table 1 also allows an impressionistic glimpse at similarities and differences between American and English undergraduate students in regard to notes, note-taking, and note-having. While there are many fancy ways of dealing with statistical results, for present purposes it seems enough to subtract the smaller percentage from the larger and see what happens. When this is done, the differences seem to fall into two groups: those yielding a relatively small absolute value,

TABLE 1
Student Attitudes Toward Note Taking
(From Hartley and Davies, 1978)

Per cent indicating "yes" to items		Statistical Measure		Item Type
USA (N=52)	UK (N=71)	Average	Difference	
				Open-ended items
98	86	92	12	Do you feel note-taking is an important activity? Why or why not?
96	83	89	13	Are there any types of lectures in which you take more notes than others? If so, please explain.
58	66	62	-8	Do you have any particular techniques in note-taking that you find especially helpful?
56	25	41	31	Has anyone encouraged and/or given you instruction in the taking of notes? To what extent?
				Yes-no items
98	84	91	14	I take notes to have review material for examinations.
94	66	80	28	I find notes useful for organizing presented material.
92	46	69	46	I find that I get a better exam mark if I take notes.
83	49	66	34	Lecturers expect you to take notes in their lectures.
75	77	76	-2	I intend to keep my notes and refer to them after the lectures are over.
71	45	58	26	Most other people take a substantial amount of notes.
67	55	61	12	I wish I had better note-taking skills.

TABLE 1 (continued)

54	59	57	-5	I sometimes find my note-taking interferes with my immediate understanding of the lecture.
40	30	35	10	I find it useful to use other people's notes.
29	32	31	-3	If it were not for exams I wouldn't take notes.
25	56	41	-31	I often doodle instead of taking notes.
10	14	12	-4	I take notes so that I won't have to read the text.

between 2 and 14, and those yielding a relatively larger absolute value, between 26 and 46. Of the 16 items asked of all respondents, 10 fall in the first or "small difference" group, and six fall in the second or "large difference" group. For only six of the questions do English undergraduate students yield a higher value than their American counterparts, and in only one case is the difference of any appreciable size.

Using the magnitude of these differences to order things, it seems as if American students are of the opinion that they get a better grade if they take notes (46), their instructors expect them to take notes (34), they have been encouraged and/or given instructions in how to take notes (31), they find notes useful for organizing material (28), and they notice that other people take a substantial amount of notes (26). English students report they often doodle instead of taking notes far more frequently than is reported by American students (-31). A quick overview of these differences suggests that American students (their classmates and professors) value note-taking far more than do their English peers who have neither been trained to take notes nor to see any particularly significant value in it. In addition, their instructors and classmates don't seem to care about note-taking nearly as much as do American instructors and classmates, and English students often doodle rather than take notes. The social pressure from both peers and lecturers to take notes is considerably more powerful in the U.S. than in the U.K.

Despite such differences, it is clear that students in both countries see some positive values to note-taking. If we employ a second,

also not very elegant, statistic, the average percent agreeing with an item, we learn that the top five items include the perception that note-taking is an important activity (92%), that notes are useful to review material for exams (91%), that certain types of lectures yield more notes than others (89%), that notes are useful for organizing material (80%), and that notes are kept and referred to after lectures are over (76%). At the other end of the spectrum, we should be glad to learn, nobody feels that notes obviate the need to read the text (12%), that if it weren't for exams people wouldn't take notes (31%), and that few students find it useful to use someone else's notes (35%). An overview of these findings suggests that students value notes both in terms of the present—they help organize lecture material—and the future—they are useful in reviewing for examinations and may serve as a reference at some later date.

A more recent survey of student attitudes and behaviors toward note-taking was conducted at the University of Minnesota by Carrier, Williams, and Dalgaard (1988). This survey asked students to describe their attitudes toward note-taking as well as to rate how frequently they engaged in specific note-taking activities. When questionnaires were analyzed, three different groupings of responses emerged: one related to the students' perception of how valuable note-taking was to them, a second to the frequency with which they took notes, and a third to their confidence or lack of confidence in how well they took notes. When Carrier and her associates attempted to determine if specific student characteristics would relate to these three factors of note-taking, they found that gender was significant to all three; that is, female students tended to value notes more highly than male students, to take more notes, and to be more confident in their note-taking ability. Although other scattered relationships were noted, none seemed as clear cut: undergraduate women are just better and more confident at note-taking than their male classmates.

Direct Observations of Note-taking

While questionnaire results are fine for determining attitudes and reports of actions, they do not follow the old research adage of when you can look as well as ask, please do. Over the past half century a number of studies have observed directly one or another aspect of note-taking on the hoof; one of the most complete studies of this type was reported by Edwin Locke of the University of Maryland in 1977. In this study, Locke tape recorded the lectures of 12 different professors and had a graduate student attend the classes as if he were an ordinary undergraduate. Locke's graduate assistant took detailed notes on the lecture, marked out ten-minute intervals in the notes he took, counted the number of students in the class, and recorded which

items were written on the board by the lecturer. If this weren't enough, he also collected the notes of students volunteering to hand them in. Using these as his text, the assistant then prepared an "ideal" set of notes based on his own in-class notes and a tape of the lecture. Each lecturer was asked to look at these notes and to correct them so as to produce an "ideal" set for his/her class for that particular lecture.

Actual student notes were then compared with the ideal set for 12 different classes ranging from art history to entomology and containing from nine to 30 students. In addition to ideal and classroom notes, course grades were collected to determine if there was any relationship between classroom notes actually taken by students and the grade they received in the course. All in all, 161 sets of notes were collected which were then examined in terms of the number of ideal thought units appearing in student notes and whether or not the instructor wrote them on the board during the lecture. As a final flourish, the number of thought units contained in the ideal set was computed for each of the 12 classes; this value was then used to compute the rate, per minute, at which the various lecturers produced thought units (i.e., ideas) in their class.

Analysis of these data yielded a number of findings: The average lecturer produced about 104 different thought units per lecture. Since the length of lecture varied from 50-75 minutes, the average rate per minute turned out to be about 1.68 with a high of 2.52 for the lecture on Chinese history and with a low of .90 for the lecture on business administration. Of these 104 thought units, student note-takers recorded about 60% of them. When this value was divided into units the lecturer actually wrote on the board and those that he or she did not, roughly 90% of the items written on the board found their way into student notes whereas only about 50% of those not written on the board found their way into student notes. If you want something at least to get into student notes, make sure you write it on the board.

The division of thought units into those that were written on the board and those that were not bore an interesting relationship to the student's grade in the course. For items appearing on the board, there was no relationship between student grade and the percentage of thought units appearing in the notes. For items <u>not</u> appearing on the board, however, there was a clearly significant relationship with students recording 25% or fewer of such unboarded thought units earning an average grade of C and with students recording 76% or more of them earning an average grade of B+. For the two groups falling between these extremes, the average grade for the 26-50% group was B- and the average grade for 51-75% group was B. In short, there was a strong, positive relationship between the student's recording of thought units <u>not</u> on the board and his or her final course

grade. Although writing on the board may get an item into the student's notes, it doesn't necessarily mean it will go from there into the student's head. What seems required to transform instructor information into student information is the student's ability to get it down when the instructor does not first write it down for him or her. It is not enough for students simply to record what gets written on the board; rather, students have to participate in the lecture in a somewhat more active way so as to make the instructor's information their information.

Locke's study produced one more interesting bit of data: When lectures were divided into three periods of approximately 20 minutes each, he discovered little difference across periods in the percentage of thought units appearing in student notes for items written on the board by the lecturer. When, however, he looked at the percentage of thought units not written on the board by the lecturer, he found a clear drop from the first to the last period with average percentages falling from a high of 57% in period one to a low of 47% in period three, with an intermediate value of 51% in period two. Although it is easy to attribute this decline to a "fatigue effect," as Locke did, what gets fatigued is not clear; and it is surely not the student's hand that we ought to be worried about. Rather, what we ought to do as lecturers is to stress to students the importance of including material that is not written on the board in their notes and to try to have them (and us) stay alert during the latter periods of the lecture. We could also help a bit by being at least as interesting at the end as at the beginning of our lectures.

At about the same time as Locke was conducting his study in 12 different American lecture halls, Pauline Nye (1978) was researching this issue in the lecture halls of New Zealand, and H. Maddox and Elizabeth Hoole (1975) were similarly engaged in the lecture halls of New South Wales. Both sets of researchers drew inspiration from earlier work done in the home office—the U.K.—by Hartley and Cameron (1967). In their original study, Hartley and Cameron compared student notes with a tape of the same lecture and were "surprised" (their word) to find that only about one-third of all ideas presented by the lecturer found their way into student notes. When the lecturer was asked to specify crucial information in the lecture, however, results indicated that students did record over 50% of such information with the highest percentages occurring during the first and fourth ten-minute segments of the lecture. Although their data were sparse, results again indicated that women took more extensive and more accurate notes than men.

In a second study, Maddox and Hoole (1975) also noted that only about 50% of the significant information in a lecture found its way into

student notes. Again confirming the Hartley and Cameron findings, female students took significantly better notes than male students. Looking at the notes themselves, it was found that students only infrequently made errors, although eight (of 56) students were found to have three or more errors in their notes. Results also indicated that the rate of note taking was uneven over various parts of the lecture with the opening segment yielding the lowest rate and with the segment during minutes 30-40 yielding the highest rate.

A final study in this series (Nye, 1978) was concerned with the effect of selected student characteristics on classroom note-taking. Results were clear again in demonstrating a significant difference in note-taking skill and frequency in favor of women students; in addition, male (but not female) students who were in their second year and beyond took more complete notes than male students in their first year. When all aspects of student notes were examined in relation to course grade, small positive relationships were found between grades and number of words in notes and between grades and the number of minor points in the lecture noted; no significant correlation was found between grades and number of major points noted.

Taken in combination, all three studies are consistent in suggesting that an examination of student note-taking provides a useful way not only of assessing what students note during a lecture but of examining the nature of college lecturing itself. On the basis of such an examination, it seems clear that information is neither presented nor recorded at a constant rate across the lecture and that students and professors agree only some of the time as to what the major points are in any given lecture. Students also seem to note just about 50% of the information in the lecture defined as significant by both groups: more when it appears on the board, less when it does not. Finally, these results suggest that not all note takers are of equal skill and that female students at all levels and male students who have been around a while are better at this activity than male students who are in their first year of college.

Further Observations of Note-taking

As part of a larger study conducted a few years ago at the Learning Research Center of The University of Tennessee concerning what students do and are aware of during college lectures (Pollio, 1984; 1990), observers were asked to record student note-taking practices in four different, large lecture classes. In this study 30 undergraduate students were observed constantly for three different 50 minute lectures divided into 30 second intervals. With the permission of both the student and the instructor, observers recorded what the

student did during each of these 300, thirty-second periods including the notes he/she did (or didn't) take.

Two different types of note-taking were recorded: those that mirrored what the lecturer wrote on the board and those that did not. These categories, termed mirrored and spontaneous note-taking, parallel to some degree the distinction between "written on the board" and "not written on the board" made by Locke in his study of note-taking at the University of Maryland. Other student actions also were recorded including looking at and laughing and/or smiling with both the instructor and one's peers, fidgeting, checking one's watch, relaxing, and so on. Observers also made global judgments during each thirty-second period as to whether the student appeared to be paying, or not paying, attention to the lecture. Finally, students were randomly and unexpectedly interrupted on four different occasions during each lecture—on an average of once every 12 minutes—at which time they were asked to write down what they were aware of just before the interruption. Although such self-reports were coded into many different content categories, the most important distinction for present purposes may be described as on-target or off-target with respect to the content of the lecture. Prior to the experiment, all students had been told that the observers were interested in ordinary, work-a-day-experiences and that anything and everything they were aware of was of interest whether or not it pertained to the lecture.

Since the degree of trust between the observer and the student attending the lecture seemed crucial for obtaining results in which we might have some confidence, the two were encouraged to share concerns and ideas with each other before actual observation took place. When both members of an observational pair were comfortable with each other and with the view that anything was permissible—we weren't looking for "perfect" student behaviors, just ordinary ones—the actual observations took place. Although a great deal of data was generated by these procedures, those concerning mirrored and spontaneous note-taking and two different measures of student attention—a global evaluation by the observer plus an evaluation of the student's own self-report—are most important in the present context.

After all measures for all intervals were coded, results indicated that students took notes, either mirrored or spontaneous, in about 57% of the intervals. Of this number, spontaneous note-taking occurred in 41% of the intervals, and mirrored note-taking took place in about 16% of the intervals. As used in this study the two categories were mutually exclusive. When observer judgments of on-target were tallied, results revealed that students looked on-target in about 95% of the intervals and off-target in only about 5% of them. When student

self-reports were scored in terms of whether they were judged to be on- or off-target with respect to lecture content, results revealed students were on-target 65% of the time and off-target 35% of the time. Comparing the two values of 95% on-target for observer judgments and 65% on-target for self-reports, we note a 30% discrepancy between two presumably comparable measures of student attention. What this discrepancy suggests is that how frequently a student looks on-target to someone else and how frequently his or her self-report may be coded as being on-target are sometimes quite different. Said another way, private reactions and public behaviors in the college classroom are different from one another in some 30% of the cases. While this difference makes sense—students, after all, can be polite even when otherwise engaged (bored, daydreaming, etc.)—it should tell us as lecturers that not everyone who looks on-target is on-target.

FIGURE 1
Mean Number of Intervals in which Students Took Spontaneous and Mirrored Notes During Fifty-Minute Lectures

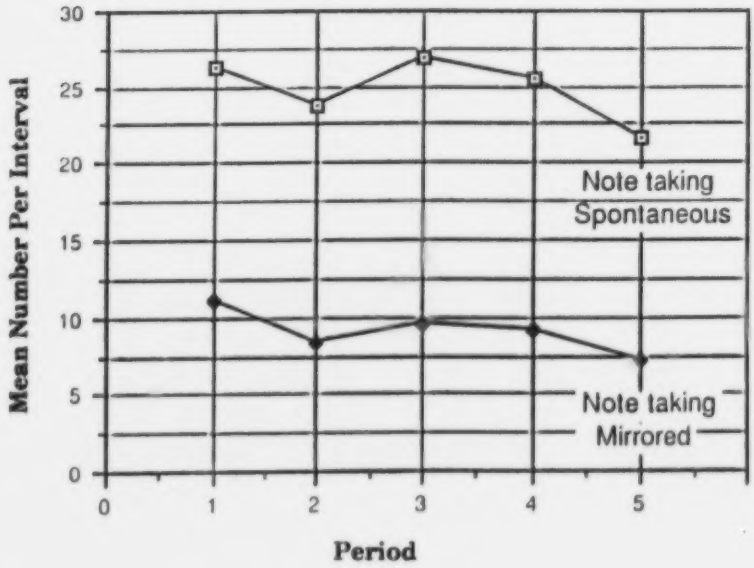
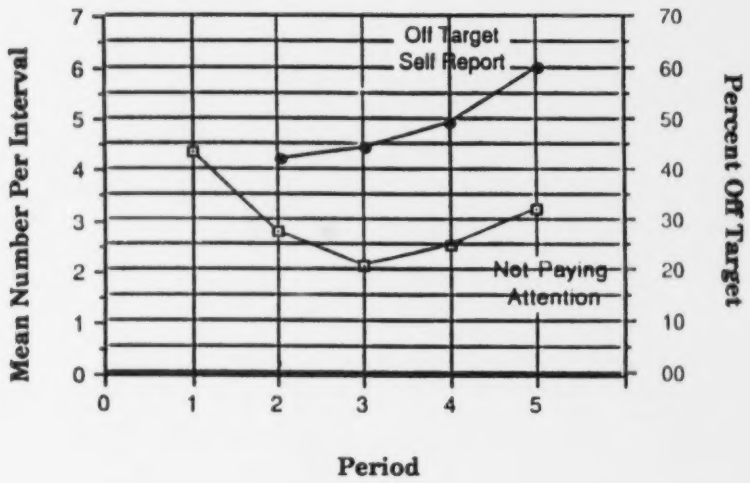


Figure 1 presents the pattern of mirrored and spontaneous note-taking as it was observed to occur for all students during the five ten-minute periods covering all 50 minutes of the lecture hour. The upper curve presents the mean number of intervals (out of a possible 60) in which students were observed to take spontaneous notes; the bottom curve provides similar results for mirrored note-taking. One can observe that the curves have approximately the same shape: both begin at a reasonably high level, drop during the second period, rise during the third period, and fall during the final two periods (slightly during fourth period and more rapidly during fifth period). If we think about these curves in terms of how much information is noted by the average college student during various portions of the lecture, it seems clear that there is a decrease from the first to last ten minutes with a significant amount of note-taking occupying the middle periods of the lecture hour.

Lest we think that this description applies only to student behavior during a lecture, it is possible to interpret the second curve not only in terms of student activity but also in terms of instructor activity—it is the instructor, after all, who writes on the board whatever it is that gets mirrored in student notes. If we take mirrored note-taking to describe the activity of the lecturer as revealed through the activity of students taking notes, it seems as if lecturers also show a peak in board-writing during the opening and middle periods of the fifty-minute lecture hour. For both curves the rate of noteworthy information is not consistent across the lecture but seems to occur in episodes that peak during the first, third, and fourth ten-minute segments.

Turning now to measures of student awareness and self-reports, consider the results provided in Figure 2. Three things need to be emphasized in regard to this figure: (a) unlike observer judgments of student attention, self-reports were gathered at four different periods during the 50 minutes, hence there are four points for self-reports and five for observer judgments, (b) the results presented in Figure 2 provide off-target values for both measures, and (c) the left margin presents values for observer judgments, and the right margin presents values for student self-reports. In general, the two curves parallel one another suggesting at the level of the class that being off-target in terms of one's own self report is in close agreement to that of looking off-target to someone else. These results also suggest a decreasing level of student attentiveness as the lecture progresses at least from the third through the fifth periods, although there is also a lack of correspondence between the two measures during the second period. Despite this discrepancy, results presented in Figure 2 offer a more congruent picture than was produced by the 30% difference

FIGURE 2
Two Measures of Student Awareness for Various Periods of a Fifty-Minute Lecture



between public and private estimates of student attention reported earlier.

To examine more directly what, if any, relationship holds between note-taking, student attention, and other classroom behaviors, correlations were computed between both types of notes (spontaneous and mirrored), both measures of attention (self-reports and observer judgments), and all other categories of student behavior evaluated in the overall study. Looking first at spontaneous note-taking, we find that it correlates negatively with not looking at the instructor and with fidgeting; we also find that it correlates positively with observer judgments of paying attention and with being on-target in terms of self-reports. Additional results indicate that it does not correlate, either positively or negatively, with mirrored note-taking, which is found to correlate positively with smiling and laughing with classmates as well as with relaxing and fidgeting.

Turning now to measures of student attention, results reveal a positive correlation between on-target self-reports and looking on-target to an outside observer. As noted, both measures correlate with spontaneous note-taking, and neither correlate with mirrored note-taking. What seems to be suggested by these patterns is that spontaneous note-taking is a highly focused and/or even asocial activity and that mirrored note-taking is a more casual activity that still allows for other, largely social, activities to go on at the same time. Since the two measures do not correlate with one another, it also appears as if we should think of them as dissimilar rather than comparable activities.

If we consider present results in conjunction with those reported by Locke (1977), we are led to the conclusion that when a student writes down in his or her notebook what the lecturer writes on the blackboard, such activity does not correlate with other measures of paying attention nor, even, with other measures of note-taking. Although it seems a heresy of sorts to conclude that board work by an instructor will have little or no positive effect on student learning and recall, it is beginning to appear, to use the old adage, that lecture information is quite capable of passing from the instructor's notes, onto the lecture blackboard, into the ear of a student, and then onto a note pad without ever engaging the mind. For the moving pencil to contact the stream of thought, more is required of the student than simply to copy what was written on the board.

Notes, Quizzes, and College Grades

While there are many reasons for a student to take notes—including that he or she might like to have them evoke Proustian remembrances of lectures past—it seems that the major reason, for at least 98% of American college students, is to have something to help them review for upcoming examinations. Although not everything believed to be valuable by college students turns out to be so, the idea that note-taking, quizzes, and grades relate to one another seems reasonable , and has a long history dating back at least as far back as 1925 when R. C. Crawford of the University of Idaho performed his classic experiments relating student notes to student performance on tests.

In these early studies, Crawford first lectured his classes as he usually did, and his students noted their notes as they usually did. Following this, students were tested on questions asking them to recall information about specific topics covered in the lecture. Student notes also were collected, and both test papers and notes were then scored in terms of how many specific points occurring in the lecture also occurred in class notes and on test papers. Notes and test papers

were scored independently of one another, and each point of information was coded into one of four categories: right, vague, wrong, or absent. Intelligence test scores were available for some, but not all, of the students whose notes and test papers had been collected and scored.

The most significant result to all this sorting and counting concerned the correlation between the total number of points in student notes and the total number present on test papers: for the seven different classes studied by Crawford such values were found to vary between .36 and .66 yielding a median value of .50. When Crawford examined the relationship between specific points in the notes and on test papers for students of different IQ levels, he found the correlation was just as high for low IQ students as for high IQ students. In one of the classes studied, Crawford also had available results of nine other classroom tests..When the total number of points correct on one lecture was correlated with scores on these nine tests Crawford found an average value of .33 suggesting that the quality of notes taken in a single lecture will predict, to some degree, the student's total course grade. This finding is similar to one reported by Locke (1977) some 50 years later: good notes yield good test scores, and good test scores yield good grades.

Crawford also performed an item by item analysis of specific points of information presented in the lecture. By consolidating the two categories of right and vague into the single category of present and the two categories of absent or wrong into the category of absent,

TABLE 2
Relationship Between Having An Item In One's Notebook and Having That Item Appear On A Class Test (From Crawford, 1925b)

Notes	Test		Totals
	Present	Absent	
Present	1277 (.27)	1224 (.26)	2501 (.53)
Absent	318 (.07)	1932 (.40)	2250 (.47)
Totals	1595 (.34)	3156 (.66)	4751 (1.00)

Crawford was able to trace the fate of specific information in both student notes and test papers. In Table 2, which offers one analysis of these results, the left-hand margin presents the presence or absence of an item in student notes and the top margin presents the presence or absence of that same item on test papers. The far right column presents the number (and percent) present or absent in notes; the bottom row presents the number (and percent) of items present or absent on the test.

In terms of test performance, only 34% of the items presented in class appeared on the examination papers received. Of this total, 27% were in the notes, and 7% were not. Of the 66% that did not appear on the test, 26% had appeared in the notes, and 40% had not. On the basis of these, and other, results Crawford concluded that it is "apparent, therefore, that taking notes on a point does not guarantee its being recalled at the time of the test, but that failure to take note of it very greatly decreases its chances of being recalled (p. 289)."

In a different and more recent, analysis of the relationship between student notes and test performance, Baker and Lombardi (1985) broke down the information presented in classroom lectures into the categories of main points, details, transitions, and examples. Results for main points, basically the category studied by Crawford, indicated that while students were able to answer correctly many points not in their notes, a main point contained in the notes was rarely answered incorrectly on a test. The same pattern applied to a lesser extent for transitions, details, and examples. More interestingly, however, an analysis of student notebooks revealed that whereas 47% of main points found their way into student notes, the value was only 30% for transitions, 13% for details, and 3% for instructor examples. The bad news is that students record very little in the way of our pet examples; the good news is that they differentiate between main points and other aspects of the lecture. When the total proportion of items noted was correlated with test scores, an overall value of .35 was noted; correlations were low but positive for main points (.27), details (.22), and transitions (.31).

In discussing the issue of course material specifically called to the students' attention by slides presented during the lecture, results indicated that almost everything contained on a slide found its way into the notebook again corroborating in a different way the finding that writing something on the board is a compelling method of having it appear in student notes. The tendency toward 100% reproduction of material contained on slides, taken in conjunction with a value of 27% for information not on slides, led Baker and Lombardi to the following, somewhat melancholy, reflection: "While a few students were exceptionally thorough note-takers, most did little more than

copy down the key terms and topic headings appearing on the transparency. A disconcerting implication is that students might take a more active role in processing lecture material if they were given no assistance. On the other hand, perhaps students would have nothing at all in their notes without these aids (p.32)."

How Do Notes Help Test Performance?

In an attempt to provide a conceptual understanding for the relationship between notes and test performance, DiVesta and Gray (1972) suggest that note-taking is helpful at two different points in the teaching-learning-testing sequence characteristic of college classrooms: during the lecture itself and prior to the examination. In the first case, notes are seen to help the student attend to and organize the material as he or she hears it; in the second, they are seen to provide a useful organizational structure for review and subsequent recall. Although both functions were suggested by prior research, including students' own explanations of why they take notes, DiVesta and Gray (1972) were the first to describe them, in the fashionable language of computer analysis, in terms of encoding and external storage functions. That is, notes help the student attend to and conceptualize material as it is encountered in class as well as to retrieve it during pretest reviews and during the examination itself. A related terminology used by Hartley and Davies (1978) presents this contrast in terms of process (encoding) and product (external storage) functions.

In a careful and extensive review of prior studies, Kiewra (1985a) evaluated the hypothesis that students who take notes during the lecture learn more and recall better than students who do not take notes during the lecture. Although we might expect unequivocal confirmation for this claim, Kiewra's review indicated that of 56 research studies, only 31 were found to provide clear evidence of a positive difference in favor of note-takers, whereas 23 were found to reveal no difference, and two were found to yield differences in favor of non-note-takers. In more naturalistic classroom studies, however, such as those of Crawford (1925a,b), Baker and Lombardi (1985), and Locke (1977), the superiority of note-taking over just listening was demonstrated quite conclusively in terms of an analysis of the difference in recall between noted and non-noted material. Across all studies considered by Kiewra in his review, the percentage of noted material recalled by students was found to vary between 35% and 70%. A similar computation for non-noted material revealed that the percentage of such material recalled by students varied from 5% to 15%.

One additional wrinkle to the way in which classroom notes might promote student learning and recall of course material concerns the practice of providing students with the instructor's notes.

The usual rationale for this practice is that providing such notes allows the student to attend more completely to the lecture as it occurs in class. Results of this practice have been somewhat inconclusive: reviewing instructor notes has been shown to yield better recall than not reviewing any notes, although reviewing one's own notes produces even better recall (Fisher and Harris, 1973; 1974). Providing students with skeleton notes, to be filled in as the lecture progresses, also has been shown to affect recall positively although effects are small at best and seem to help poor note-takers more than skillful ones (Howe and Godfrey, 1971). Since many students fall in the former category, Kiewra's (1985b) suggestion that reviewing good (instructor) notes is better than reviewing poor notes seems well taken. To his recommendation that "instructors should be encouraged to provide students with relatively clear notes," we feel obliged to add that it would probably be best to help them develop their own set of notes for purposes of review. As Baker and Lombardi (1985) noted in their lament, we can always make our students too passive, and if good notes promote good recall, we should help students learn how to come up with their own notes rather than provide them with someone else's notes however good these notes might be.

A relatively simple way in which to help poor note-takers take better notes is to encourage them to tape record the lecture and then take notes later at their leisure. Once a lecture has been recorded, poor note-takers not only will be able to go over the material one more time but will have a more extended opportunity to recast its content in more concise, conceptual form. For certain students, the use of a tape recorder not only provides an efficient form of external storage but also encourages them to recast lecture content into a personally more useful organization. By using a tape recorder, students who have difficulty in conceptual listening and/or summarizing lecture material as it is presented in class will be able to perform these activities as well as their more fortunate classmates, especially if we encourage them to review and notate such material at their own pace.

This last point suggests that not all notes are created equal and that not all students engage lecture content in a transformative or even conceptual way. For some students, taking notes simply means recording information verbatim, and we should therefore never assume that note-taking invariably leads to a deep, conceptual recording of lecture content. Sometimes the encoding phase of note-taking yields only a simple list of facts and events. Under this condition, it is difficult to evaluate the claim that student recall is facilitated by deeper levels of encoding information presented in lectures since this level is not matter of factly reached by most student notes.

Turning now to the external storage (or product) function of classroom notes, Kiewra's (1985) review also computed a batting average for the positive effects of review (vs non review) on recall and found that of 22 different studies, 17 produced significant effects yielding an overall value of .772—good enough to win the batting title in either the National or American Leagues of Social Science. While reviewing one's notes clearly facilitates test recall, it is not clear exactly how such review operates to produce this effect. Probably the simplest explanation is that post-notetaking review, in addition to providing one more opportunity to consider the material, allows the student an additional opportunity to relate it to a wider network of concepts and ideas. Under this latter interpretation, simple rehearsal or repetition is not the best procedure for producing better recall. Rather, it seems that if student review were devoted to some sort of reorganizing and/or reconceptualization of course content, then student learning (and test performance) would improve. Such a suggestion implies that reviewing one's notes for a test, in addition to providing one more opportunity for rehearsal, also serves to provide another, different, and more conceptual reorganization of the material—a second chance at better encoding, if you will.

Finally there is the question of how different test types affect the relationship between notes and test performance. In a series of studies dealing with just this issue, Peper and Mayer (1978; 1986) were concerned not only with whether or not note-taking improved overall test performance but also with whether note-takers and nonnote-takers performed equally well on rote recall and problem-solving tests. On the basis of five different studies concerning a number of different academic content areas, Peper and Mayer demonstrated that in immediate tests of recall note-takers were worse than non-note-takers on verbatim recognition tasks and better on problem-solving tasks. In addition, they also discovered that when note-takers were familiar with test content no such effect was found but that when they were unfamiliar with content these effects again appeared. They also found that students with poor math ability (MSAT less then 550) showed stronger effects of note-taking on problem solving tasks than students with more accomplished math ability (MSAT greater than 550); differences between groups were considerably less obvious when students were evaluated on recognition tasks.

In discussing these results, Peper and Mayer note that had they looked only at verbatim recall they would have found little effect of note-taking on test performance. Remember, 23 of 56 studies considered by Kiewra (1985a) reported this result. However, when Peper and Mayer varied the test from one of verbatim recognition to

problem-solving, they found that while note-taking had little or no positive effect on rote performance, it did have a significant positive effect on problem-solving. Such results suggest that note-taking has its major impact not in terms of an ability to increase student attention nor in the terms of how deeply note-taking forces the student to encode classroom material into existing conceptual categories. Rather, these results suggest that note-taking facilitates learning by enabling the student to relate new material to existing knowledge in such a way as to have it make sense in a variety of actual and potential situations. Such a view of note-taking predicts that "note-takers are more likely to integrate new information with old, and non-note-takers are more likely to encode the information as presented." At its worst, note-taking simply records facts without changing the learner; at its best, note-taking transforms instructor knowledge into student knowledge which enables the student to use that information in new and different problem contexts. In either case, instructors will only be able to discern how well students have used their notes to learn course content if they evaluate student learning on the basis of tests that require problem solving as well as the rote recall of information.

Different Notes for (and by) Different Folks

Anytime a specific human activity is considered in detail, the effects of individual differences make their appearance. In the case of note-taking and note-using, for example, these differences can be as obviously relevant as the student's level of mathematical ability or as seemingly irrelevant as whether or not the student is male or female. The case with respect to student note-taking is no different from any other: personal characteristics affect how, when, and if note-taking will be done and whether or not it will be effective in promoting learning and recall.

Although many different student characteristics, in addition to those of gender or topic-specific ability, have been considered, perhaps the most theoretically interesting one concerns good and poor short-term memory. While common sense might lead us to suppose that notes help a poor memory more than a good memory, the research literature may be understood to say something quite different. Consider some experiments by Berliner (1969; 1971) in which he first determined how well students performed on a number of short-term memory tasks. Following this, students having both good and poor short-term memory listened to a 45 minute video taped lecture. Some of the students were asked simply to "pay close attention to the tape," others were asked to take notes, still others were interrupted and asked questions during the lecture.

If we concern ourselves with only the first two groups, recall tests

given immediately after the tape as well as one week later showed that taking notes served to improve test performance for students having good short-term memories and to interfere with test performance for students having poor short-term memories. Berliner interpreted these results to suggest that taking notes involves two different and overlapping processes: one which requires the student to hold the necessary information in short-term memory before writing it down, and a second which requires the student to write down information previously presented at the same time as new material is still being held in memory. If the student transforms such prior information as he or she transcribes it, the demands on short-term memory are further increased thereby making the recall task that much more difficult.

The implications of Berliner's studies—in addition to debunking the common sense notion that note-taking primarily helps a poor memory—serve to indicate how complex an activity it is to take notes while listening to a lecture. Not only does material communicated orally have to be attended to, it also has to be held in memory long enough for it to be transformed into written form. For the case of useful notes, the transformation not only has to change spoken into written words but, more importantly, to transform the information into a useable form for subsequent review and recall. While all of this is going on, the student is requested to continue to pick up new information which will then go through the same encoding-transforming-transcribing sequence.

Far from being a simple task, classroom note-taking is a complex event defined by a set of intellectual skills (attention, encoding, transformation, and transcription) more appropriate to summarizing a complicated text than jotting down a telephone number. Unlike the needed, but unknown, telephone number (which may be dialed and forgotten or looked up again as needed) the purpose of classroom notes is to enable a student to learn and know in the years beyond the lecture. If all our notes did was to help us recall forgettable information such as a telephone number they, and our lectures, would be much less than we might wish them to be. The end product of any lecture is a change in what the student knows not only in the short run but for a lifetime. While it may be nice to have an undergraduate career reevoked by old notebooks, it would be a sad fact indeed if we were unable to recognize the content of our notebooks as something we still knew. Good notes are a means to an end, never the end itself.

Guidelines for Lecturers and Note-takers

Because note-taking is a complex intellectual activity, it seems that we, as lecturers, should be able to facilitate student note-taking

TABLE 3
Some Implications of Current Research for Promoting and Improving Student Note-Taking

1. Take time at the beginning of the course to talk about note-taking. Help students learn how to organize their notes so that the conceptual structure of the material is more apparent.

2. Make clear the organizing principle(s) of a lecture; pay attention to transitions as well as to content. Make sure to note and emphasize relationships among related lectures.

3. Use verbal "signposts" in the lecture to provide cues as to when something important is being presented.

4. Write on the blackboard those points you want in the notes; do not encourage verbatim copying but do encourage students to conceptualize and elaborate upon the points written on the board.

5. Separate the tasks of listening and note-taking, particularly when presenting slides, graphs, and/or transparancies. Allow students to use tape recorders if they choose.

6. Be especially concerned about students getting down the information at the end of the lecture; they, and you, tend to be less attentive during this period than during any other.

7. When collecting feedback from students, ask about your lecture in terms of ease of note-taking.

8. Encourage students to take notes; if possible, examine what they have written and suggest how note-taking might be improved.

9. Help students reorganize material in their notes at review sessions prior to tests. Remind them of how what they are learning relates to higher order concepts in the field.

10. Use lecture notes as a basis for at least some test questions.

in the hope of facilitating student learning. Some aspects of lecturing already do this—lecturers regularly repeat their main points and often embellish them with stories, anecdotes, and examples so as to increase their attention-getting value and, hopefully, make the material personally and/or professionally relevant to the student. While some of us who lecture know and use our own little gambits to get things into student notebooks and minds, the research literature does offer some reasonably clear advice on how to promote and improve student note-taking.

Table 3 presents ten different implications of current research for helping students learn better from classroom lectures on the basis of helping them take better notes. If we look at the complete list a curious but undeniable conclusion that emerges is that good lecturing leads to good note-taking. If the lecturer prepares his or her comments so that they can be followed both in terms of content and structure, and if the lecturer encourages students to process information both when heard in class and when reviewing for an examination and, finally, if the lecturer requests students to provide feedback on how easy or difficult it was to note significant ideas in his or her class, then the notes taken by students in class not only will reflect course content but also the student's own unique appropriation of such content. When this occurs, we are led to the conclusion that the real purpose of classroom note-taking is not note-having nor even doing well on tests; rather the real purpose is to enable course information to become an integral part of what the student knows. When this happens, note-taking may be put in its proper perspective as a technique enabling students to acquire classroom material that changes not only what they know, but also how they know it, and what they will be able to do with it in the years following graduation. When this occurs, student notes (and we) will have done all that can be expected of them (and us).

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W. Lee Humphreys, Director
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Knoxville, Tennessee 37996-4001

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